Requirements of the Ground System for the Swift Mission

Revision 1.0

The Ground Network for Swift
410.4-SPEC-0007

September 12, 2000 v1.0

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Foreword

This document, "Requirements of the Ground System for the Swift Mission", defines the requirements that must be met by the ground system. Changes require approval of the GNEST Configuration Control Board.

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1.0 Swift Operations Overview

1.1 Swift Operations Objectives

Swift operations are designed to achieve Swift science objectives in a framework that allows broad participation by the astronomy community while maintaining the health and safety of the spacecraft and instruments.

1.2 Swift Science Operations Strategy

The science objectives require

- observations of about 500 gamma-ray bursts (GRBs) in 3 years
- follow-up observations of GRB afterglows
- rapid delivery of results and data to the community
- delivery of data analysis tools to the community
- a survey of the sky in hard X-rays
- detections of transients in the hard X-ray survey
- observations of targets of opportunity (TOOs)

All data from the Swift mission will be public immediately. Observing time will not be selected by proposals.

1.3 Implementation of Strategy

The Ground Network for Swift (GNEST) is the organizational entity responsible for implementing the operations strategy.

The ground system consists of several groups. The Mission Operations Center (MOC) is responsible for operating the spacecraft and its payload. It will be developed and run by the Pennsylvania State University (PSU) and it will be located near State College, Pennsylvania. The Swift Data Center (SDC) is responsible for processing Swift telemetry into scientifically useful data sets and for making these data available to the community. The U.S. Swift Data Center (SDC) will be located at GSFC; the Italian Data Archive Center (ISAC) and a data center in the United Kingdom will provide services for scientists in those countries. The Swift Science Center (SSC) at GSFC will support the community with data analysis and will also provide tools for analyzing Swift data. The Italian Space Agency's (ASI) Malindi ground station and NASA's

Space Network (SN) will provide the primary communication links with Swift. A TBD commercial ground station will be used as needed. The instrument teams are responsible for providing detailed knowledge of the operation and calibration of the instruments. The spacecraft contractor SpectrumAstro will provide detailed knowledge of the operation of the spacecraft. The GNEST Manager provided by the Laboratory for High Energy Astrophysics (Code 660) of GSFC, has overall responsibility for the delivery of the ground system.

The Swift Principal Investigator (PI) is the ultimate authority for all decisions concerning the mission. The Swift Science Team (SST) will review the implementation strategies of the ground system and provide recommendations to the PI.

1.4 Archive Strategy

Data will be processed through several processing levels. Level 0 data refers to files of time-ordered telemetry packets. The telemetry will be converted into FITS files to make the Level 1 data sets. This conversion process will maintain all the information in the original telemetry packets. The Level 1 data are converted to Level 2 data by converting housekeeping data to physical units and applying calibration information.

All data from Swift observations will be available for public access as soon as they are put into scientifically useful formats. There is no proprietary period for any data. The data will be rapidly delivered to the three Swift data centers for public access. The High Energy Science Archive Research Center (HEASARC) is the designated U.S. data center responsible for public access and long-term archive.

1.5 Applicable Documents

The following documents take precedent over the current document. In case of conflicting requirements, requirements given in these documents will apply.

“Swift Science Requirements Document”, 410.4-SPEC-0005.

“Swift Mission Requirements Document”, 410.4-SPEC-0004.

Swift Interface Requirements Document”, GSFC-730-SWIFT-IRD.

“Swift Project Service Level Agreement”.

2.0 Science Operations Scenario

This section provides a brief description of typical operations. These descriptions should not be treated as requirements. Requirements are stated explicitly in Section 4.

2.1 Pre-planned Observations and GRBs

1. The MOC will maintain a long-term timeline showing current plans for monitoring of GRBs, TOOs, and other targets. It is anticipated that this plan will cover several weeks. The plan will be revised as more is learned about the sources.
2. Several days in advance, the MOC will produce a detailed observation schedule showing all significant on-board activities for the spacecraft and instruments. This schedule will include attitudes, maneuver times, SAA passages, and contacts with ground stations and TDRSS.
3. From the detailed observation schedule, the MOC generates instrument and spacecraft command loads. It is anticipated that command loads will be uploaded about once per working day.
4. Scheduled observations can be interrupted autonomously by the spacecraft when new GRBs are detected. The Figure-of-Merit processor will decide whether to interrupt planned observations and will produce a modified schedule. After completion of the automated GRB observing sequence, the spacecraft will return to the original observing plan.
5. A member of the MOC staff will be alerted that the GRB was detected and the schedule revised if deemed necessary. The MOC will normally revise observing plans to monitor the new GRB for times beyond those covered by the autonomous spacecraft response. How quickly the revisions will be made depends on the available resources and the characteristics of the new GRB.
6. Initial information (alerts) about the new GRB will be sent to the Gamma-Ray Coordinates Network (GCN) for distribution to the community. Quick-look analysis of data will be carried out in the MOC and results posted to the Swift Web page and sent to the GCN as appropriate.
7. The MOC will produce Level 0 telemetry files and send them to the SDC at GSFC for processing. The resulting data files and standard products will be sent to the HEASARC and other data centers for access by the community.

2.2 Targets of Opportunity.

Discovery of a TOO, either with the BAT or with other means, may cause the planned science schedule to be modified. The TOO may be the discovery of a new source or a change of state of a known source. GRBs discovered with Swift are not TOOs. The decision to observe the TOO with Swift will be made according to guidelines approved by the Swift PI. The following is a typical scenario after the discovery.

1. The MOC informs the Swift PI or his designated representative of the discovery.
2. The MOC makes an initial assessment of the nature of the target and the scientific desirability of observing the TOO. The MOC also assesses the impact of such an observation on the current observing plan.
3. The MOC informs the Swift PI or his designated representative of their assessments.
4. The Swift PI decides whether to observe the TOO.
5. The MOC sends a command through TDRSS to observe the source and/or produces an update plan to be uploaded during a ground contact.

3.0 Assumptions

3.1 Malindi

3.1.10 The Malindi ground station will provide command and data capture services for Swift.

3.1.20 The station will provide real-time housekeeping data to the MOC during contacts.

3.1.30 The station will capture all other data from telemetry dumps and send the data to the MOC within 2 hours of the end of the contact. The station will store all the data for at least 7 days.

3.1.40 The station will schedule at least TBD minutes of contacts per week.

3.1.50 The station will develop contact acquisition data (e.g., spacecraft azimuth and elevation) from NORAD two-line element data provided by the MOC.

3.1.60 The station will measure the arrival time of specified telemetry to an accuracy of at least 50 microseconds at least once per day.

3.1.70 The station will ship telemetry from a single pass to the MOC within 120 minutes.

3.2 Space Operations Management Office (SOMO)

3.2.10 Flight Dynamics Facility (FDF) will provide orbit determination for the first week of the mission. The accuracy will be sufficient for acquisition.

3.2.20 Swift will use the Demand Access System to send unscheduled messages to the ground. All messages will be delivered to the Swift processors at GSFC and to the MOC within 5 seconds of their generation.

3.2.30 Swift will send commands using unscheduled MA forward time. Such times are documented in the TDRSS Unscheduled Time (TUT) report.

3.2.40 Swift requires a dedicated line with a capacity of at least 56 kbps from White Sands through GSFC to the MOC.

3.2.50 Ranging data are required for the first week of the mission.

3.3 High Energy Astrophysics Archival Research Center (HEASARC)

3.3.10 The HEASARC will provide for public, electronic access to Level 1 data, further processed data, and analysis results.

3.3.20 The HEASARC is responsible for the long-term archive of Swift data.

3.3.30 The HEASARC will provide and maintain tools for finding data from specific observations and transferring the data to users.

3.3.40 The HEASARC will maintain the HEAsoft infrastructure including multi-mission analysis tools, and CALDB.

3.3.50 The HEASARC will distribute new builds of FTOOLs that include Swift-specific tools developed by the GNEST.

3.4 Others

3.4.10 The PI or his designated representative is responsible for accepting or rejecting TOO requests. The PI may also choose to implement a modified version of the request.

3.4.20 Any dedicated data link between the SDC and ISAC and the UK Data Center is the responsibility of the ISAC or UK Data Center.

3.4.30 The instrument teams will document the required calibration observations.

4.0 Requirements of the Ground System for Mission Operations and Data Analysis

4.1 Mission Planning and Scheduling

4.1.10 The MOC shall schedule all activities for the Swift observatory except those scheduled autonomously by the spacecraft.

4.1.20 The MOC shall produce time-ordered, short-term schedules listing all significant activities of the spacecraft and instruments and their times. The activities include science observations with target identification, spacecraft maneuvers, contacts with ground stations, and SAA passages.

4.1.30 The MOC shall produce time-ordered, long-term schedules listing all observations planned for the next 2 months.

4.1.40 The MOC shall develop the strategy for scheduling observations.

4.1.50 The MOC shall post a description of the scheduling strategy to a Web page for examination by the user community.

4.1.60 The MOC shall schedule observations so that the observing constraints concerning the health and safety of the instruments and spacecraft are not violated.

4.1.70 The MOC shall schedule observations based on the expected amount of good science time, taking into account the amount of time that would be affected by occultation by the earth or high particle background or other instrument observing constraints.

4.1.80 Times in the short-term schedules shall have a resolution of 60 seconds.

4.1.90 The MOC shall have the ability to produce short-term schedules covering at least 7 days with at least 100 observations per day.

4.1.100 When staffed, the MOC shall have the ability to reschedule the short-term schedule covering 24 hours in less than 2 hours after the relative science priorities of targets have been decided.

4.1.110 The MOC shall be able to revise the short-term schedule to include observations of a new GRB during the first working day after the GRB is detected.

4.1.120 The MOC shall schedule calibration observations required to maintain knowledge of the response of the instruments.

4.1.130 The MOC shall produce an as-flown timeline for each day of the mission. The timeline will contain a time-ordered list of target names, target positions, instrument configurations, maneuver times, and orbital events affecting good observing times.

4.1.140 The MOC shall deliver electronically each as-flown timeline to the SDC within 7 days of the timeline execution.

4.1.150 The MOC shall maintain a Web page for community access that contains the as-flown timelines for the last 30 days, the current short-term schedule, and the current long-term schedule.

4.1.160 The MOC shall propagate orbital elements provided by NORAD for use in mission planning.

4.1.170 The MOC shall provide to Malindi, the backup ground station, and the SN orbit elements needed to develop contact acquisition data.

4.1.180 The MOC shall produce a long-term schedule for the first 30 days of the mission that includes the plans for the activation and check-out of the spacecraft and instruments that are developed by the spacecraft vendor and instrument teams respectively.

4.2 Target of Opportunity Requirements

4.2.10 The MOC shall provide a Web-based form for users to request TOO observations.

4.2.20 The MOC shall acknowledge TOO requests within 1 hour of their receipt.

4.2.30 The MOC shall inform the requestor of the decision about the TOO within 24 hours of the decision.

4.2.40 The MOC shall maintain for the duration of the mission an electronic archive of TOO requests and their disposition.

4.2.50 The MOC shall make a technical evaluation of the impact on spacecraft resources and the observation program before initiating a change to the observing plan for a TOO.

4.2.60 The MOC shall provide within one working day to the PI or his designated representative a technical evaluation of all TOO requests.

4.2.70 The MOC shall establish an automatic procedure for assessing the urgency of TOO requests. The assessment shall include the need for rapid response, the credibility of the requestor, and the scientific merit of the goals of the TOO.

4.2.80 The MOC shall have the ability to schedule at least one high priority TOO per week.

4.2.90 For high-priority TOOs the MOC shall provide the technical evaluation of the TOO request within 6 hours of its receipt.

4.2.100 For high-priority TOOs the MOC shall prepare commands for the new observation and request a TDRSS forward link within 1 hour of the receipt of direction from the PI or his designated representative.

4.2.110 The MOC shall develop an automatic system for evaluating GCN alerts from other instruments about newly detected GRBs. Alerts satisfying TBD criteria that indicate Swift may want to observe the GRB will cause automatic paging of operations staff .

4.3 Commanding

4.3.10 The MOC shall schedule the command contacts with Swift.

4.3.20 The MOC shall have the ability to command Swift using Malindi, the SN, and the backup commercial station.

4.3.30 The MOC shall generate and send all commands to the observatory.

4.3.40 The MOC shall have the ability to send real time commands, sequences of commands to be stored on the spacecraft for later execution, table loads, and software loads to the observatory.

4.3.50 The MOC shall have the ability to accept software and table loads from the spacecraft vendor, FoM processor developers, and instrument teams for subsequent transmission to the observatory.

4.3.60 The MOC shall verify the correct receipt of commands by the spacecraft.

4.3.70 The MOC shall verify all command loads against constraints prior to uplink.

4.3.80 The MOC shall maintain the instrument command and telemetry database. Critical commands and any sequences of commands that could pose a danger to the instruments will be identified in the database.

4.3.90 The MOC shall maintain the spacecraft command and telemetry database. Critical commands and any sequences of commands that could pose a danger to the spacecraft will be identified in the database.

4.3.100 The MOC shall provide protection against the unintentional issue of critical commands.

4.3.110 The MOC shall verify receipt and execution of commands and computer loads by the spacecraft and instruments.

4.3.120 The MOC shall maintain an electronic log of commands sent and verified. The MOC shall deliver updates to this log covering one mission day to the SDC within 7 days of when the commands were executed.

4.3.130 The MOC shall be able to schedule stored commands with a resolution of 1 second.

4.3.140 The MOC shall have the ability to send observation requests to the FoM processor.

4.3.150 The MOC shall have the ability to send commands to change parameters of the FoM processor.

4.4 Data Capture and Processing

4.4.10 The MOC shall manage the Swift command and telemetry system, including managing the spacecraft recorder, scheduling contacts, and recording the data received from the ground stations.

4.4.20 The MOC shall monitor on receipt the quality and completeness of the telemetry that it receives. The MOC shall request re-transmission from the ground stations or the spacecraft as needed.

4.4.30 The MOC shall maintain a record of the quality and completeness of the telemetry for the duration of the mission.

4.4.40 The MOC shall automatically monitor the delivery of telemetry data from ground stations and alert the operations staff when they are not received in the required time.

4.4.50 The MOC shall maintain a copy of all telemetry data, definitive orbit data, spacecraft clock offset measurement data, and production Level 0 data for the duration of the mission.

4.4.60 The MOC shall provide remote access to the stored telemetry packets for the spacecraft vendor and instrument teams.

4.4.70 The Ground System shall be able to process and store data volumes corresponding to the expected spacecraft and instrument data rates. The data rates are given in Section 4.12 of the MRD.

4.4.80 The MOC shall produce the final, time-ordered, duplicate-removed data set of Swift telemetry (the production Level 0 data). The data set shall contain at least 95% of the telemetry received by the ground stations.

4.4.90 The MOC shall deliver the production Level 0 data for a day to the SDC within 7 days of the production of the corresponding data packets on the spacecraft.

4.4.100 The MOC shall produce quick-look Level 0 data sets. This time-ordered, duplicate-removed data set of Swift telemetry will be made within 60 minutes after the receipt of data by the MOC from a ground-station contact. The data set should contain at least 80% of the telemetry received by the ground stations. The data shall be delivered to the SDC within 30 minutes of its production.

4.4.110 The MOC shall deliver to the SDC all messages received through TDRSS within 60 minutes of their receipt.

4.4.120 The MOC shall process all messages sent through TDRSS within 60 s of their receipt.

4.4.130 The MOC shall maintain for the duration of the mission a list of all messages sent through TDRSS.

4.5 Mission Monitoring

4.5.10 The MOC shall monitor the telemetry for spacecraft and instrument health and safety.

4.5.20 The MOC shall establish a system that can automatically send alphanumeric pages to selectable members of the Swift team to alert them of important events in the MOC or on the spacecraft.

4.5.30 The MOC shall maintain a list of "red" and "yellow" limits for the appropriate parameters in the housekeeping data. The MOC shall document the appropriate response for each possible limit violation.

4.5.40 The MOC shall maintain a database of spacecraft and instrument housekeeping data. Data from the entire mission shall be available. Data from the most recent 30 days of the mission shall be available on-line.

4.5.50 The MOC shall establish a system for generating graphical and numeric displays of the database of housekeeping data. For on-line data, the system shall be capable of displaying trends of at least 5 parameters simultaneously at a rate of at least 10 times real time.

4.5.60 The MOC shall process real-time housekeeping data as it is received. Violation of "red" or "yellow" limits will generate alarms including paging of operations staff when the MOC is not staffed.

4.5.70 The MOC shall establish a system for displaying housekeeping data on monitors. The system shall be capable of displaying any housekeeping parameter. Limit violations shall be displayed prominently.

4.5.80 The MOC shall examine all housekeeping data for limit violations

4.5.90 The MOC shall verify that Swift is pointing at the planned sequence of targets (or new GRBs) and that the instruments are producing science data at acceptable rates. Data from each ground station contact shall be examined within 60 minutes of its receipt. Unexpected deviations shall cause paging of operations staff.

4.5.100 Messages containing alerts of a spacecraft emergency shall cause paging of the operations staff. The paging shall be initiated within 60 seconds.

4.5.110 GRB alerts sent through TDRSS meeting TBD criteria shall cause paging of the operations staff. The criteria will be based on the contents of the message.

4.5.120 The MOC shall verify at least once a month that the pointing performance of the spacecraft meets specifications.

4.5.130 The MOC shall produce definitive after-the-fact orbit data. The data shall contain the satellite position at one-minute intervals with TBD accuracy. Each orbit data product will cover one mission day. The orbital elements used to produce the data shall be provided with the data.

4.5.140 The MOC shall deliver definitive orbit data products to the SDC no later than 7 days after the end of the associated mission day.

4.5.150 The MOC shall maintain the spacecraft clock to within TBD ms of UTC.

4.5.160 The MOC shall maintain knowledge of the difference between the spacecraft clock and UTC with an accuracy of 10 ms. The results of each measurement of the offset of the spacecraft clock shall be archived.

4.5.170 The MOC shall deliver electronically the results of each measurement of the clock offset to the SDC within 7 days of the measurement.

4.5.180 The MOC shall provide remote access to Swift telemetry to authorized operations personnel. Simultaneous access by at least 4 staff members shall be supported.

4.5.190 The MOC shall support remote access to data over the Internet using ITOS for the spacecraft vendor and instrument teams. Simultaneous access by at least 4 people shall be supported.

4.6 Science Data Analysis

4.6.10 The SSC shall maintain knowledge of the calibration of the instruments (including aspect, energy gain and resolution, background, dead times) and provide this information to observers. The instrument teams are responsible for performing the data

analysis needed to determine the calibration of their instruments, and the teams are responsible for developing any special analysis tools required. The SSC is responsible for collecting the calibration information from the instrument teams.

4.6.20 The SSC shall deliver the calibration information to the HEASARC for use with CALDB.

4.6.30 The SSC shall have the predicted calibration of the instruments available before launch.

4.6.40 The SDC shall convert the production Level 0 data into FITS files (production Level 1 data) that contain all the information in the telemetry. The FITS files shall comply with OGIP standards. The software shall be produced by the SDC based on documentation of the spacecraft and instrument telemetry provided by the spacecraft vendor and instrument teams.

4.6.50 The SDC shall develop a production pipeline processing system for producing Level 1 data, Level 2 data, and standard product data from production Level 0 data.

4.6.60 The SDC shall deliver the production pipeline processing system to the ISAC and UKDC. Re-deliveries shall be made whenever changes are made to the system.

4.6.70 The SDC shall convert the production Level 1 production data into Level 2 data, which contain calibrated science data. The software for converting BAT, XRT, and UVOT data shall be provided by the BAT team, the ISAC, and the SSC respectively.

4.6.80 The SDC shall produce “standard products” for each observation. The products are not required to include analysis of the BAT survey data. For the XRT, these products shall include an integrated image, source detection and identification, and light curve and pulse height distribution for the brighter sources. For the UVOT, these products shall include images for each filter used, source detection and aspect solution determination, and light curves for the brighter sources. Any special analysis tools required for producing standard products for the BAT, XRT, and UVOT data shall be provided by the BAT team, the ISAC, and the SSC respectively. The tools shall be FTOOLs that comply with OGIP standards.

4.6.90 The BAT team shall search the BAT data for hard X-ray transients, respond to TDRSS alerts about such transients, request TOOs for such transients, and announce their discovery via IAU Circulars or other appropriate means.

4.6.100 The pipeline processing system shall be operable at the SDC, ISAC, and UK Data Center. The system shall use computers using the Linux operating system. The centers shall adopt common computer systems to facilitate this requirement.

4.6.110 The SDC shall produce a quick-look processing system for processing quick-look data.

4.6.120 For BAT survey data, the system shall make Level 1 data. For all other data the system shall produce quick-look Level 1, Level 2, and standard product files.

4.6.130 The SDC shall provide public, electronic access to the quick-look data. The data shall be publicly available within 2 hours of the receipt of Level 0 data.

4.6.140 The SDC production processing system shall be able to process a typical day's worth of data in less than 12 hours.

4.6.150 The BAT team shall process the hard X-ray survey data from the BAT. The results (TBD) from this analysis shall be delivered to the SSC. The SSC shall deliver the results to the HEASARC.

4.6.160 The BAT team shall automatically process GRB alerts from the spacecraft. Alerts satisfying appropriate quality criteria shall be reformatted and sent to the GCN. Processing speeds are specified in Section 6.1.3 of the IRD.

4.6.170 The BAT team shall automatically process alerts about non-GRB transient sources. Alerts satisfying TBD criteria shall cause paging of BAT personnel.

4.7 Data Archiving

4.7.10 The SDC shall deliver Level 1 and all further products to the HEASARC within 7 days of the receipt of the corresponding production Level 0 data from the MOC.

4.7.20 The SDC shall make the Level 1 and higher products available to the Swift data centers in Italy and England at the same time it delivers the data to the HEASARC.

4.7.30 Unless special processing is requested, the Swift data centers shall provide users with identical data files for each observation.

4.8 User Program Services

4.8.10 The SSC shall prepare and maintain a detailed statement of Swift capabilities.

4.8.20 The SSC shall make available detailed documentation of analysis software, "cookbooks", manuals, and public data sets.

4.8.30 The SSC shall make available expert advice in analyzing observations.

4.8.40 The SSC shall provide a data analysis package that includes all the FTOOLs used to make the standard products.

4.9 Data Interfaces

4.9.10 The MOC shall maintain communication with both the command and the data capture elements of the Space Network System on a dedicated and restricted network.

4.9.20 The MOC shall maintain dedicated communication links with Malindi and the backup ground station.

4.9.30 The MOC shall establish and maintain a data connection to the SDC with a capacity of at least 1 Mbps.

4.10 Operating Plans

4.10.10 The MOC shall be staffed with a single shift.

4.10.20 The MOC shall operate autonomously whenever it is not staffed.

4.10.30 The MOC shall devise and implement plans for returning to operational status within 12 hours of any hardware problem in the MOC.

4.10.40 The MOC shall document plans for dealing with disruptions of utility services to the MOC including electrical power, data services, and telephone services.

4.10.50 The MOC shall support automated ground station pass execution including command uploads and playback of recorded data.

4.10.60 The MOC systems for data capture, data processing, mission monitoring and supporting contacts with ground stations shall be capable of operating autonomously for at least 72 hours.

4.10.70 The MOC shall use the Integrated Test and Operations System (ITOS). The telemetry and command data base files, procedures, configuration files, display definitions, and telemetry output files of the system shall be compatible with the ITOS system used for I&T.

4.10.80 The MOC shall maintain electronically accessible documentation of mission operating procedures. These procedures shall be maintained under configuration control and access shall be limited to operations personnel.

4.10.90 The MOC shall satisfy the security requirements for connecting to the SN data distribution network (open IONET).

4.10.100 The MOC shall restrict physical access to authorized personnel.

4.10.110 The MOC shall restrict computer access to authorized personnel using a firewall and one-time passwords or other equivalent techniques.

4.10.120 The MOC shall provide TBD facilities to representatives of the spacecraft vendor and instrument teams at the MOC during LEO.

4.10.130 The SDC system for data processing shall be capable of operating autonomously for at least 72 hours.

4.10.140 The SDC shall devise and implement plans for returning to operational status within 72 hours of any hardware problem in the SDC.

4.10.150 The MOC, SDC, and SSC shall each produce a product verification plan.

5.0 Definitions

ASI	Italian Space Agency
BAT	Burst Alert Telescope
FDF	Flight Dynamics Facility
FITS	Flexible Image Transport System
FoM	Figure of Merit
GCN	Gamma-ray Coordinates Network
GNEST	Ground Network for Swift
GRB	Gamma Ray Burst
GSFC	Goddard Space Flight Center
HEASARC	High Energy Astrophysics Science Archive Research Center
IRD	Interface Requirements Document
ISAC	Italian Swift Archive Center
ITOS	Integrated Test and Operations System
LEO	Launch and Early Orbit
MOC	Mission Operations Center (at PSU)
MODA	Mission Operations and Data Analysis
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications
NORAD	North American Aerospace Defense Command
PI	Principal Investigator
SAA	South Atlantic Anomaly
SDC	Swift Data Center
SN	Space Network (of TDRSS)
SOMO	Space Operations Management Office
SSC	Swift Science Center
SST	Swift Science Team
TBD	To Be Determined
TDRSS	Tracking and Data Relay Satellite System
TOO	Target of Opportunity
TUT	TDRSS Unscheduled Time
UKDC	United Kingdom Data Center for Swift
UVOT	Ultra-violet and Optical Telescope
XRT	X-ray Telescope

6.0 Summary of Modifications

V0.01 on January 25, 2000. First version.

V1.0 on September 12, 2000. First signed version.